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### **Tax Principles and Tariff-Tax Reforms under International Oligopoly**

**Kenji Fujiwara**

School of Economics, Kwansei Gakuin University

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**SCHOOL OF ECONOMICS  
KWANSEI GAKUIN UNIVERSITY**

1-155 Uegahara Ichiban-cho  
Nishinomiya 662-8501, Japan

# TAX PRINCIPLES AND TARIFF-TAX REFORMS UNDER INTERNATIONAL OLIGOPOLY

KENJI FUJIWARA\*  
*Kwansei Gakuin University*

## Abstract

This paper, in a two-country duopoly model, compares destination- and origin-based commodity taxes in a context of a unilateral tariff-tax reform that fixes the world price and foreign welfare. We find that the proposed reform reduces domestic welfare, and hence is strictly Pareto-deteriorating under the destination principle while the opposite holds under the origin principle. Moreover, it is shown that this ranking is reversed if exports are taxed. In short, which is preferable between destination and origin taxation depends on the tax principle and which between imports and exports are taxed.

*Keywords:* tax principles, tariff-tax reform, destination-based consumption tax, origin-based production tax.

*JEL Classifications:* F12, F13, H2.

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\*Kenji Fujiwara, School of Economics, Kwansei Gakuin University, Uegahara 1-1-155, Nishinomiya, Hyogo, 662-8501, Japan (kenjifujiwara@kwansei.ac.jp). I thank two anonymous referees and an associate editor for a number of helpful comments. In particular, Section 4 is entirely indebted to the referees' suggestions. Any remaining error is my own.

## 1. Introduction

This paper compares destination-based consumption taxes and origin-based production taxes in a context of tariff-tax reforms and imperfect competition.<sup>1</sup> Rapid growth of world trade led by reductions in protective trade measures is expected to guarantee welfare gains for the world as well as an individual country.<sup>2</sup> However, there is still hesitation to liberalize trade. One main reason is that developing countries are concerned about future losses in trade tax revenue that has a large share in total government revenue.<sup>3</sup> Resistance to trade liberalization is also found in developed countries since it inevitably leads to an uneven income distribution as the factor endowment models, e.g., the specific-factors model and the Heckscher-Ohlin model, suggest.<sup>4</sup>

In order to overcome these difficulties and facilitate trade liberalization, the international institutions, e.g., the IMF and the World Bank, have been proposing a policy reform consisting of trade tax reductions and accommodating adjustments of domestic taxes. In seminal works, Hatzipanayotou et al. (1994) and Keen and Ligthart (2002) prove that a small open country gains in welfare and government revenue from one unit tariff reduction and one unit destination-based consumption tax increase. Keen and Ligthart (2005), in contrast, demonstrate that the same no longer survives a duopoly model.<sup>5</sup> While these papers focus on a consumption tax as domestic taxation, Emran (2005) and Emran and Stiglitz (2005) consider the case in which

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<sup>1</sup>We interchangeably use two terminologies a ‘destination-based tax’ (resp. ‘origin-based tax’) and a ‘consumption tax’ (resp. ‘production tax’) unless any confusion arises.

<sup>2</sup>Baier and Bergstrand (2001, p. 22) find evidence that ‘tariff reductions still explain three times as much trade growth as transport-cost declines.’ Love and Lattimore (2009, p. 60) estimate welfare gains from tariff reductions.

<sup>3</sup>IMF (2005, p. 3) clearly reports this trend, concluding that ‘trade tax revenue typically constitutes between one-quarter and one-third of total tax revenue in low- and middle-income countries.’ Baunsgaard and Keen (2010) find evidence that revenue recovery fails in low-income countries.

<sup>4</sup>See, for example, Chapters 4 and 5 in Krugman et al. (2010).

<sup>5</sup>Extending the Keen-Ligthart (2005) model, Naito and Abe (2008) and Fujiwara (2012) find a welfare- and revenue-improving possibility.

an origin-based production tax is available.

Apart from the above works, there is a large literature comparing destination and origin tax principles in open economies.<sup>6</sup> It is fair to say that consumption taxes give rise to higher welfare under perfect competition and a noncooperative tax setting (Mintz and Tulkens, 1986, Lockwood, 1993, Kanbur and Keen, 1993, and Lockwood, 2001), but the results are very sensitive to a subtle difference in assumptions once imperfect competition is introduced. For instance, by assuming a non-cooperative tax setting in an integrated duopoly market, Keen and Lahiri (1998) show that production taxes are preferred, but Haufler et al. (2005) find that this result does not survive market segmentation with a high transport cost.<sup>7</sup> Turning attention to tax harmonization, Keen and Lahiri (1993) and Keen et al. (2002) show the superiority of consumption taxes.

Combining the above two strands of literature, this paper compares two tax principles in a context of a unilateral tariff-tax reform. More specifically, we focus on a policy reform composed of tariff reductions and adjustments in either consumption or production taxes that fix the world price.<sup>8</sup> The reasons for considering this reform are as follows. First, this reform, which is based on an observable variable (world price), can fix foreign welfare, and so it neither is a beggar-thy-neighbor policy nor induces foreign retaliation.<sup>9</sup>

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<sup>6</sup>Lockwood (2001) and McCracken and Stahler (2010) offer a comprehensive survey on the comparison of two tax bases under perfect competition and imperfect competition, respectively.

<sup>7</sup>Haufler and Pfluger (2004) also show the invalidity of the Keen-Lahiri (1998) result in a monopolistically competitive model.

<sup>8</sup>One may claim that the reform that fixes the consumer price and/or government revenue is more worthwhile to try. However, we do not deal with them not because they are uninteresting but because they are technically difficult to analyze. In contrast, world-price-fixing reforms have received attention in a context of *multilateral* trade reforms, e.g., Bagwell and Staiger (1999) and Mrazova (2011).

<sup>9</sup>The idea of fixing welfare of the rest of the world dates back to Vanek (1965), Ohyama (1972), and Kemp and Wan (1976) in an argument of customs unions, and Lahiri and Raimondos-Moller (1997) apply it to a context of a tariff-foreign-aid reform, but they admittedly state that ‘the information requirement (of the foreign-welfare-fixing reform) is quite demanding.’ (p. 487)

Second, this requirement allows us to easily find whether the reform achieves a strict Pareto improvement, i.e., it improves domestic welfare, and makes the foreign country no-worse-off without any international lump-sum transfer.<sup>10</sup>

Under the above motivations, we develop a simple two-country duopoly model to examine the welfare implications of the world-price-fixing tariff-tax reform, with special attention paid to the comparison of tax principles. We show that employing destination-based consumption taxes adjusted to import tariff reductions worsens domestic welfare, and leads to a strict Pareto deterioration, but adjusting origin-based production taxes raises domestic welfare, and yields a strict Pareto improvement. Moreover, this superiority of the origin tax is completely reversed if imports are taxed. These findings may contribute to the literature on tax principle comparisons in open economies, e.g., Keen and Lahiri (1993, 1998) in a context of a noncooperative tax setting and Keen et al. (2002) in a context of tax harmonization.

This paper is planned as follows. Presenting a model, Section 2 examines the case of destination-based consumption taxes. Section 3 turns to the case of origin-based production taxes. Section 4 addresses two relevant issues overlooked in the previous sections. Section 5 concludes. Appendix gives mathematical derivations of the main results.

## **2. Destination-Based Consumption Tax**

### **2.1. Preliminaries**

This section presents a model. Suppose a two-country (Home and Foreign), two-good (Goods 1 and 2) world in which Good 1 (non-numeraire) is duopolistically supplied by a Home and a Foreign firms, and Good 2 (numeraire) is competitively supplied by price-taking firms. Throughout this

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<sup>10</sup>In the literature on tax harmonization, it is usually presupposed that international income transfers are available. However, this assumption is quite restrictive as is well-recognized in the literature. For example, Keen (1989, p. 2) states that ‘in practice there is little prospect of appropriate inter-country transfers being made.’

paper, we assume an integrated world market and linear demand and costs of production.<sup>11</sup> An asterisk (\*) is attached to all the Foreign variables.

The preference of each country's representative consumer is given by a quasi-linear utility function  $u(C_1) + C_2$  and  $u^*(C_1^*) + C_2^*$ , where  $C_i$  and  $C_i^*$ ,  $i = 1, 2$  are the consumption of each good, and  $u(\cdot)$  and  $u^*(\cdot)$  are an increasing and strictly-concave function. Letting  $p$  and  $p^*$  denote the (consumer) price of Good 1 measured by Good 2 for each country, utility maximization under the budget constraint yields the demand functions of Good 1:

$$C_1 = D(p) \equiv u'^{-1}(p), \quad C_1^* = D^*(p^*) \equiv u^{*'}^{-1}(p^*).$$

The Home government levies an import tariff  $t$  and a destination-based consumption tax  $\tau$  while Foreign observes laissez-faire.<sup>12</sup> Then, an arbitrage leads to relationships that  $p = p^W + t + \tau$  and  $p^* = p^W$ , where  $p^W$  is the world price, and the world market-clearing condition is given by

$$D(p) + D^*(p - t - \tau) = X + Y,$$

where  $X$  and  $Y$  are the output of the Home firm and the Foreign firm, respectively. Solving this equation for  $p$ , we obtain the inverse demand function  $p(X + Y, t + \tau)$  with the following properties:

$$p_Q(X + Y, t + \tau) \equiv \frac{\partial p(X + Y, t + \tau)}{\partial (X + Y)} = \frac{1}{D' + D^{*'}} < 0 \quad (1)$$

$$p_T(X + Y, t + \tau) \equiv \frac{\partial p(X + Y, t + \tau)}{\partial (t + \tau)} = \frac{D^{*'}}{D' + D^{*'}} > 0, \quad (2)$$

where  $Q \equiv X + Y$  and  $T \equiv t + \tau$ .

From these assumptions, the profit of each firm is defined by

$$\text{Home firm} : p(X + Y, t + \tau)X - cX - \tau X$$

$$\text{Foreign firm} : p(X + Y, t + \tau)Y - c^*Y - tY - \tau Y,$$

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<sup>11</sup>We have confirmed that the results in this paper survive the case of segmented markets.

<sup>12</sup>Note that the export tax case corresponds to the negative value of  $t$ . For the time being, we regard  $t$  as an import tariff, and the export tax case will be addressed later. And, we discuss a situation where Foreign takes some trade policy in Section 4.2.

where  $c \geq 0$  and  $c^* \geq 0$  are the marginal cost. The first-order conditions for profit maximization are

$$\begin{aligned} Xp_Q(X+Y, t+\tau) + p(X+Y, t+\tau) - c - \tau &= 0 \\ Yp_Q(X+Y, t+\tau) + p(X+Y, t+\tau) - c^* - t - \tau &= 0. \end{aligned}$$

Having in mind the linear demand such that  $p_{QQ} = p_{QT} = p_{TT} = 0$ , totally differentiating this system yields<sup>13</sup>

$$\begin{bmatrix} 2p_Q & p_Q \\ p_Q & 2p_Q \end{bmatrix} \begin{bmatrix} dX \\ dY \end{bmatrix} = \begin{bmatrix} -p_T \\ -p_T + 1 \end{bmatrix} dt + \begin{bmatrix} -p_T + 1 \\ -p_T + 1 \end{bmatrix} d\tau, \quad (3)$$

from which the comparative statics outcomes become:

$$\frac{\partial X}{\partial t} = \frac{-p_T - 1}{3p_Q}, \quad \frac{\partial Y}{\partial t} = \frac{-p_T + 2}{3p_Q}, \quad \frac{\partial X}{\partial \tau} = \frac{\partial Y}{\partial \tau} = \frac{-p_T + 1}{3p_Q}. \quad (4)$$

## 2.2. Reform

We now define the tariff-tax reform. As mentioned in Introduction, we focus on the reform that consists of a reduction in tariffs and an adjustment in consumption taxes in a way to keep the world price unchanged. Since the world price is equal to  $p^W = p(X+Y, t+\tau) - t - \tau$ , this requirement is given by

$$dp^W = \left[ p_Q \frac{\partial(X+Y)}{\partial t} + p_T - 1 \right] dt + \left[ p_Q \frac{\partial(X+Y)}{\partial \tau} + p_T - 1 \right] d\tau = 0.$$

Substituting (4) into this equation, the two taxes must change according to

$$d\tau = - \frac{p_Q \frac{\partial(X+Y)}{\partial t} + p_T - 1}{p_Q \frac{\partial(X+Y)}{\partial \tau} + p_T - 1} dt = - \frac{p_T - 2}{p_T - 1} dt. \quad (5)$$

Eq. (5) has two notable properties. First, the consumption tax has to be raised since (5) is rewritten as

$$d\tau = - \frac{2D' + D^{*'}}{D'} dt,$$

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<sup>13</sup>In what follows, we suppress the arguments of  $p(\cdot)$  unless any confusion arises.

and the coefficient of  $dt < 0$  in the right-hand side is negative. The reason is simple upon invoking that the effects of import tariffs are decomposed into those of consumption taxes and production subsidies. Tariff reductions, which are regarded as simultaneous reductions in consumption taxes and production subsidies, increase domestic consumption and decrease domestic production, thereby increasing Home's imports. As a result of increased imports of Home, the world price would rise if no policy were accommodated. Accordingly, the Home government is required to raise the consumption tax to suppress the increase in Home's imports and to fix the world price.

Second and more importantly, the consumption tax must be raised more than the magnitude of the tariff cut, i.e.,  $|d\tau| > |dt|$ . This is because the consumption tax is the only policy instrument (other than the tariff) available to the Home government. If the Home government were to use the production tax/subsidy as well as the consumption tax, it could offset the effect of tariff reduction by raising the production subsidy and consumption tax. However, since the Home government can use only the consumption tax, which can not play the dual role above, it ends up over-taxing domestic consumption.

Substituting (5) into the right-hand side of (3), it becomes

$$\begin{bmatrix} -p_T + (-p_T + 1) \frac{p_T - 2}{-p_T + 1} \\ -p_T + 1 + (-p_T + 1) \frac{p_T - 2}{-p_T + 1} \end{bmatrix} dt = \begin{bmatrix} -2 \\ -1 \end{bmatrix} dt.$$

Therefore, the rest of our task is to make comparative statics by replacing the right-hand side of (3) with the above vector. The effect of the proposed reform on outputs is thus obtained as follows.

$$\left. \frac{\partial X}{\partial t} \right|_{dp^W=0} = -\frac{1}{p_Q}, \quad \left. \frac{\partial Y}{\partial t} \right|_{dp^W=0} = 0. \quad (6)$$

Note here that both consumer surplus and the firm profit of Foreign are unaltered with this suggested tariff-tax reform, and so does the Foreign welfare. That is, the world-price-fixing tariff-tax reform is equivalent to the foreign-welfare-fixing reform. This is a novel property of the world-price-fixing reform since it is in practice impossible or too costly to fix foreign



welfare, but our reform can achieve the same goal based on an observable variable (world price). Furthermore, this property allows us to know whether the reform achieves a strict Pareto improvement just by checking its welfare effect on Home. In other words, the reform is strictly Pareto-improving if and only if it improves the Home welfare. The next subsection is devoted to considering whether this is the case.

### 2.3. Welfare Effects

Home's welfare consists of consumer surplus  $CS$ , the firm profit  $\Pi$  and government revenue  $G$ , each of which is defined by

$$CS \equiv u(D(p(X + Y, t + \tau))) - p(X + Y, t + \tau)D(p(X + Y, t + \tau)) \quad (7)$$

$$\Pi \equiv p(X + Y, t + \tau)X - cX - \tau X \quad (8)$$

$$G = \tau D(p(X + Y, t + \tau)) + t[D(p(X + Y, t + \tau)) - X], \quad (9)$$

where  $X$  and  $Y$  depend on  $t$  and  $\tau$  through the two first-order conditions. Combining the foregoing arguments with these definitions of welfare components, we establish:

**PROPOSITION 1:** *A coordinated tariff reduction combined with an increase in destination-based consumption tax fixing the world price reduces the Home welfare, and achieves a strict Pareto deterioration.*

(Table 1 and Figure 1 around here)

Resorting to the first row of Table 1, we interpret Proposition 1 intuitively. As mentioned in details, the Home government over-taxes domestic consumption to offset the effect of a tariff reduction on the world price. As a result, the demand curve of the world as well as Home shrinks, which, in turn, leads the Home firm to decrease output while the Foreign firm's output remains unchanged. This situation is illustrated in Figure 1 where the

duopolists' reaction curves are depicted.<sup>14</sup> The pre-reform reaction curves are given by a bold locus, and  $E$  is the initial Cournot-Nash equilibrium. When the Home government reduces an import tariff, the Home firm's reaction curve shrinks, and the Foreign firm's reaction curve expands. The reaction curves after tariff cuts are depicted as a dashed locus. If the Home government raises a destination-based consumption tax so as to keep  $Y$  constant, both firms' reaction curves shrink, and the post-reform equilibrium moves to  $E'$ . Obviously, the Home firm's output decreases from  $X$  to  $X'$ .

In other words, the suggested reform has an anti-competitive effect, and so the domestic (consumer) price rises, which has a negative impact on consumer surplus. Furthermore, output contraction of the Home firm leads to its profit loss. Although the effect on government revenue is ambiguous, the overall effect on Home welfare necessarily becomes negative because the welfare loss of the consumer and firm plays a dominant role regardless of the sign of the effect on government revenue.<sup>15</sup> In view of that this reform leaves Foreign as well off as before, this reform is strictly Pareto deteriorating. The anti-competitive effect of the reform is a key behind this result.

While the foregoing argument focuses on the case in which  $t$  is an import tariff, it is readily modified to allow for the export tax case in which  $t$  is negative, and  $dt > 0$  represents an export tax reduction. Then, we have:

**COROLLARY 1:** *A coordinated export tax reduction combined with an decrease in destination-based consumption tax fixing the world price raises the Home welfare, and achieves a strict Pareto improvement.*

In this case, the world-price-fixing reform serves as a pro-competitive

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<sup>14</sup>In our simple model, the Home firm's reaction curve is ensured to be steeper than the Foreign firm's reaction curve, and hence the Cournot-Nash equilibrium is stable since the slope of the former is  $-2$  and that of the latter is  $-1/2$ .

<sup>15</sup>All we can say is that our reform increases revenue if the initial consumption tax is sufficiently low. See Section 4.1.

policy since it expands the world demand curve, and hence the Home firm increases output. All we have to do is to reverse the above argument. Then, the world gains from the pro-competitive gains.

### 3. Origin-Based Production Tax

#### 3.1. Preliminaries

This section turns to using an origin-based production tax associated with tariff reductions. We will show that the world-price-fixing tariff-tax reform becomes a strictly Pareto-improving, and thereby contrasts to the case of destination-based consumption taxes. We briefly sketch this result since all the manipulations are essentially the same as those of the last section.

The arbitrage condition between the Home and Foreign markets gives  $p = p^W + t$  and  $p^* = p^W$ , which yields the following market-clearing condition:

$$D(p) + D^*(p - t) = X + Y,$$

and an inverse demand function  $p(X + Y, t)$  with the following properties:

$$p_Q(X + Y, t) = \frac{1}{D' + D^{*'}} < 0, \quad p_t(X + Y, t) = \frac{D^{*'}}{D' + D^{*'}} > 0. \quad (10)$$

Since the Home government imposes a production tax  $s$  instead of a consumption tax, the profit of each firm is defined by

$$\begin{aligned} \text{Home firm} & : p(X + Y, t)X - cX - sX \\ \text{Foreign firm} & : p(X + Y, t)Y - c^*Y - tY, \end{aligned}$$

The first-order conditions for profit maximization are

$$\begin{aligned} Xp_Q(X + Y, t) + p(X + Y, t) - c - s & = 0 \\ Yp_Q(X + Y, t) + p(X + Y, t) - c^* - t & = 0, \end{aligned}$$

from which the totally differentiated system is

$$\begin{bmatrix} 2p_Q & p_Q \\ p_Q & 2p_Q \end{bmatrix} \begin{bmatrix} dX \\ dY \end{bmatrix} = \begin{bmatrix} -p_t \\ -p_t + 1 \end{bmatrix} dt + \begin{bmatrix} 1 \\ 0 \end{bmatrix} ds. \quad (11)$$

The comparative statics outcomes are

$$\frac{\partial X}{\partial t} = \frac{-p_t - 1}{3p_Q}, \quad \frac{\partial Y}{\partial t} = \frac{-p_t + 2}{3p_Q}, \quad \frac{\partial X}{\partial s} = \frac{2}{3p_Q}, \quad \frac{\partial Y}{\partial s} = \frac{-1}{3p_Q}. \quad (12)$$

### 3.2. Reform

Noting that the world price is  $p^W = p(X + Y, t) - t$ , the requirement of freezing the world price is given by

$$dp^W = \left[ p_Q \frac{\partial(X + Y)}{\partial t} + p_t - 1 \right] dt + p_Q \frac{\partial(X + Y)}{\partial s} ds = 0.$$

Substituting (12) into this equation, the two taxes must change as follows.

$$ds = -\frac{p_Q \frac{\partial(X+Y)}{\partial t} + p_t - 1}{p_Q \frac{\partial(X+Y)}{\partial s}} dt = (-p_t + 2)ds. \quad (13)$$

Eq. (13) allows us to know two key properties of the tariff-tax reform that are parallel with the case of consumption taxes. To know them, it is useful to rewrite (13) by using (10):

$$ds = \frac{2D' + D^{*'}}{D' + D^{*'}} dt.$$

This form tells (i) that the production tax must be lowered as an import tariff is reduced, i.e.,  $ds < 0$  and (ii) that more than one dollar of production tax must be lowered when one dollar of tariff is reduced, i.e.,  $|ds| > |dt|$ . The reason for these properties is as follows. As already argued, a tariff reduction has an effect equivalent to a consumption tax reduction and a production subsidy reduction as a result of reduced tariffs. Therefore, the Home imports increase since the domestic consumption expands and domestic production contracts. Unless any policy is accommodated, the world price would rise. In order to cancel this effect out, the Home government needs to encourage domestic production by either lowering the production tax or subsidizing. Furthermore, the production tax must be over-reduced since it is the only policy instrument available to the Home government, which alone can not affect domestic consumption.

Substituting (13) into the right-hand side of (11), it becomes

$$\begin{bmatrix} -p_t + (-p_t + 2) \\ -p_t + 1 \end{bmatrix} dt = \begin{bmatrix} 2(-p_t + 1) \\ -p_t + 1 \end{bmatrix} dt.$$

Therefore, all we have to do is to compute the comparative statics outcomes by using the above right-hand side. The output effects of this reform become

$$\left. \frac{\partial X}{\partial t} \right|_{dp^W=0} = \frac{-p_t + 1}{p_Q}, \quad \left. \frac{\partial Y}{\partial t} \right|_{dp^W=0} = 0. \quad (14)$$

Thus, it is easily inferred that Foreign's welfare remains constant with this policy reform since no change in the world price and Foreign output implies that neither consumer surplus nor the firm profit changes.

### 3.3. Welfare Effects

The components of Home's welfare are

$$CS \equiv u(D(p(X + Y, t))) - p(X + Y, t)D(p(X + Y, t)) \quad (15)$$

$$\Pi \equiv p(X + Y, t)X - cX - sX \quad (16)$$

$$G = sX + t[D(p(X + Y, t)) - X], \quad (17)$$

where  $X$  and  $Y$  depend on  $t$  and  $s$  through the two first-order conditions. Making an argument parallel to Proposition 1, we arrive at:

**PROPOSITION 2:** *A coordinated tariff reduction combined with a decrease in origin-based production tax fixing the world price raises the Home welfare, and achieves a strict Pareto improvement.*

(Figure 2 around here)

The intuitions behind Proposition 2 are provided by referring to the second row of Table 1. What deserves attention is that the effect of the reform is completely the opposite between the cases of consumption and production

taxes. As mentioned, a tariff reduction is accompanied by an over-reduction in the production tax to neutralize the effect on the world price. This results in an increase in the Home firm's output since the effective marginal cost ( $c + s$ ) falls.

Figure 2 graphically makes clear the above mechanism. In the figure, the initial Cournot-Nash equilibrium is  $E$  at which the pre-reform reaction curves (bold loci) intersect. Due to a tariff reduction, each firm's reaction curve shifts to the dashed locus. Since the present reform requires the Home government to over-reduce the origin-based production tax, the Home firm's reaction curve shifts to the right. Then, the post-reform equilibrium becomes  $E'$  at which the Home firm increases output. To summarize, the proposed reform has a pro-competitive effect.

Recalling that the Foreign firm's output is unchanged, consumer surplus of Home increases due to the decline in the domestic price, and the Home firm gains in profits. While it is unclear whether the government revenue increases, Home gains from this reform since the pro-competitive and profit-shifting effects play a dominant role in the overall effect.<sup>16</sup> Invoking that the Foreign welfare remains unchanged, this implies that the reform yields a strict Pareto improvement.

While the preceding argument is confined to the import tariff case, it is easily modified to the export tax case by assuming  $t < 0$  and  $dt > 0$ . Then, we have:

**COROLLARY 2:** *A coordinated export tax reduction combined with an increase in origin-based production tax fixing the world price reduces the Home welfare, and achieves a strict Pareto deterioration.*

Propositions 1 and 2, together with Corollaries 1 and 2, may provide a

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<sup>16</sup>As shown in Section 4.1, this reform reduces government revenue if the production tax is initially high enough.

new insight on the comparison of commodity tax principles in open economies that has been analyzed in a context of a non-cooperative tax setting (Keen and Lahiri, 1998, Haufler and Pfluger, 2004, and Haufler et al., 2005) and tax harmonization (Keen and Lahiri, 1993, and Keen et al., 2002). According to our results, which tax principle should be adopted highly depends on both (i) whether the commodity tax is destination- or origin-based, and (ii) whether the trade tax is levied on imports or exports. In particular, the second criterion has been overlooked in the previous studies all of which assume away trade policies.

## 4. Discussions

This section addresses three important issues that are neglected in the previous sections. First, we consider the effect of the world-price-fixing tariff-tax reform on government revenue. Second, we extend the foregoing arguments to the situation where the Foreign government is not passive. And finally, we comment the validity of our results in other market structures.

### 4.1. Revenue Effects

The preceding arguments have focused on the welfare effects of the policy reform. But, as mentioned in Introduction, the effects on government revenue are the most important concern particularly for developing countries since they heavily depend on trade tax revenue. Thus, this subsection turns attention to the revenue effects of the reform.

From Eqs. (20) and (24), it is ambiguous whether our policy reform increases government revenue, depending on the initial consumption or production tax. Eq. (20) allows us to know that the world-price-fixing tariff-tax reform increases government revenue if the initial consumption tax is low enough to satisfy

$$\tau < \left( \frac{D}{p_T - 1} - X \right) p_Q.$$

In order to seek the intuition behind this finding, it is useful to decompose the revenue effect as follows:<sup>17</sup>

$$dG = \underbrace{Dd\tau}_{(+)} + \underbrace{\tau dD}_{(-)} + \underbrace{(D-X)dt}_{(+)} + \underbrace{td(D-X)}_0,$$

by totally differentiating (9). That is, if the initial value of  $\tau$  is sufficiently small, the positive effects dominate and revenue increases. At this stage, one may guess that the reform improves revenue if the Home government optimally chooses  $t$  and  $\tau$  initially. This conjecture is correct because the optimal consumption tax is computed as  $\tau = Xp_Q < 0$ , which satisfies the above inequality.<sup>18</sup>

Similar arguments are possible for the case of production taxes. From Eq. (24), the sufficient condition for the proposed reform to enhance government revenue becomes

$$s > -\left(\frac{D}{p_t - 1} + X\right)p_Q.$$

In other words, the revenue effect is positive if the initial production tax is high enough. The reason for this is clarified by totally differentiating (17):

$$dG = \underbrace{Xds}_{(-)} + \underbrace{s dX}_{(+)} + \underbrace{(D-X)dt}_{(-)} + \underbrace{td(D-X)}_0,$$

and invoking that  $ds < 0$ ,  $dX > 0$ ,  $dt < 0$  and  $d(D-X) = 0$ . Moreover, the revenue effect is necessarily negative if optimal taxes are initially chosen. This is because the optimal production tax is derived as  $s = Xp_Q < 0$ , which violates the above sufficient condition for revenue increases.

## 4.2. Foreign Trade Policy

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<sup>17</sup>Note that  $d\tau > 0$ ,  $dD < 0$ ,  $dt < 0$  and  $d(D-X) = 0$ .

<sup>18</sup>The optimal taxes are simply obtained by solving the two equations  $\partial W/\partial t = \partial W/\partial \tau = 0$ .



Sections 2 and 3 have presumed that Foreign observes laissez-faire. However, this assumption is not essential for the main results. To show this, let us assume that the Foreign government subsidizes its export, and the subsidy rate is denoted by  $\sigma$ .<sup>19</sup> Then, the Foreign domestic price is given by  $p^W + \sigma$ , where  $p^W$  is the world price. And, Foreign welfare consists of consumer surplus  $CS^*$ , the Foreign firm's profit  $\Pi^*$ , and an export subsidy payment  $G^*$ :

$$\begin{aligned} CS^* &\equiv u^* \left( D^* (p^W + \sigma) \right) - (p^W + \sigma) D^* (p^W + \sigma) \\ \Pi^* &\equiv (p^W + \sigma - c^*) Y \\ G^* &\equiv -\sigma [Y - D^* (p^W + \sigma)]. \end{aligned}$$

At this stage, we continue to assume a unilateral policy reform, i.e., Foreign does not change  $\sigma$ .<sup>20</sup> Then, it follows that  $CS^*$ ,  $\Pi^*$  and  $G^*$  are all unchanged with the world-price-fixing reform since it leads to  $dp^W = 0$  and  $dY = 0$ . In short, all the results in the last sections are valid even in the presence of Foreign policies.

### 4.3. Market Structure

We finally comment the validity of our findings. Interestingly, we have confirmed that exactly the same conclusions as Propositions and Corollaries 1 and 2 can be established in a perfectly competitive general equilibrium model and in a duopoly with segmented markets. Looking at the literature on trade policies, their effects are sensitive to a subtle difference in assumptions regarding the market structures (perfect competition, oligopoly or monopolistic competition), and so on.<sup>21</sup> In contrast, our results survive both perfect competition and imperfect competition in the form of a Cournot oligopoly. In

<sup>19</sup>Negative  $\sigma$  represents an export tax.

<sup>20</sup>While multilateral reforms that involve a change in both countries' policies are worth considering, they are beyond the scope of this paper, and hence we do not consider.

<sup>21</sup>Markusen and Venables (1988), Helpman and Krugman (1989) and Brander (1995) are, in a context of strategic trade policies, a representative work that makes clear how the optimal trade policies are affected by the difference in assumptions.

this sense, they may be useful for a practical policy-making concerning the move from destination to origin tax bases proposed by the EU.

## 5. Concluding Remarks

By considering a policy reform consisting of a trade tax reduction and an accommodating adjustment in a domestic commodity tax to fix the world price (and hence the Foreign welfare), we have compared a destination-based consumption tax and an origin-based production tax. It is proved that if the reforming country imposes an import tax, its reduction and an increase in the consumption (resp. a decrease in the production tax) that leave the world price constant achieve a strict Pareto deterioration (resp. improvement), namely, they lower (resp. raise) the Home welfare without affecting the Foreign welfare. As a by-product of this conclusion, we have shown that this result is reversed if the trade tax is an export tax. We hopefully believe that these findings would make sense over the debate which tax base is preferable that has been made in a context of noncooperative tax setting and tax harmonization.

Despite the above novelty, we admittedly leave much unexplored. First, there are alternative strategies of tax reforms. The world-price-fixing reform we propose has an advantage stressed in Introduction, but one can propose another reform strategy, e.g., a revenue-neutral reform that leaves the government revenue unchanged. Second, we have focused on a unilateral reform because we guess that it is much more costly and difficult to reach an agreement under multilateral reforms. However, we do not at all claim that considering multilateral reforms is meaningless. It is future research agenda to pursue the robustness of our results by taking into account these aspects.

## Appendix

*Proof of Proposition 1:* Taking into account that the two taxes must change

according to (5), differentiating (7) with respect to  $t$  yields

$$\left. \frac{\partial CS}{\partial t} \right|_{dp^W=0} = -D \left[ p_Q \left. \frac{\partial(X+Y)}{\partial t} \right|_{dp^W=0} + p_T \left( 1 + \frac{\partial \tau}{\partial t} \right) \right] = -\frac{D}{p_T - 1}, \quad (18)$$

where use is made of (6). Analogously, the change in  $\Pi$  associated with the reform is

$$\left. \frac{\partial \Pi}{\partial t} \right|_{dp^W=0} = X p_Q \left. \frac{\partial Y}{\partial t} \right|_{dp^W=0} + \left[ p_T \left( 1 + \frac{\partial \tau}{\partial t} \right) - \frac{\partial \tau}{\partial t} \right] = 2X. \quad (19)$$

Finally, the effect on government revenue is

$$\begin{aligned} \left. \frac{\partial G}{\partial t} \right|_{dp^W=0} &= D \frac{\partial \tau}{\partial t} + \tau D' \left[ p_Q \left. \frac{\partial(X+Y)}{\partial t} \right|_{dp^W=0} + p_T \left( 1 + \frac{\partial \tau}{\partial t} \right) \right] + D - X \\ &\quad + t \left\{ D' \left[ p_Q \left. \frac{\partial(X+Y)}{\partial t} \right|_{dp^W=0} + p_T \left( 1 + \frac{\partial \tau}{\partial t} \right) \right] - \left. \frac{\partial X}{\partial t} \right|_{dp^W=0} \right\} \\ &= \frac{D}{p_T - 1} - X + (t + \tau) \frac{D'}{p_T - 1} + \frac{t}{p_Q} \\ &= \frac{D}{p_T - 1} - X - \frac{\tau}{p_Q}, \end{aligned} \quad (20)$$

where the last line uses  $D' = (-p_T + 1)/p_Q$ .

Aggregating (18), (19) and (20) and rearranging the terms, the welfare effect on Home is derived as

$$\left. \frac{\partial W}{\partial t} \right|_{dp^W=0} = X - \frac{\tau}{p_Q} = -(p - c) (D' + D^{*'}) > 0, \quad (21)$$

where the first-order condition of the Home firm's profit maximization is utilized. Eq. (21) suggests that the proposed reform reduces Home welfare.

*Proof of Proposition 2:* Considering that  $s$  must change according to (13), differentiating (15), (16) and (17) with respect to  $t$  yields

$$\left. \frac{\partial CS}{\partial t} \right|_{dp^W=0} = -D \left[ p_Q \left. \frac{\partial(X+Y)}{\partial t} \right|_{dp^W=0} + p_t \right] = -D \quad (22)$$

$$\left. \frac{\partial \Pi}{\partial t} \right|_{dp^W=0} = Xp_Q \left. \frac{\partial Y}{\partial t} \right|_{dp^W=0} + Xp_t - X \frac{\partial s}{\partial t} = 2(p_t - 1)X \quad (23)$$

$$\begin{aligned} \left. \frac{\partial G}{\partial t} \right|_{dp^W=0} &= X \frac{\partial s}{\partial t} + s \left. \frac{\partial X}{\partial t} \right|_{dp^W=0} + D - X \\ &\quad + t \left\{ D' \left[ p_Q \left. \frac{\partial (X + Y)}{\partial t} \right|_{dp^W=0} + p_t \right] - \left. \frac{\partial X}{\partial t} \right|_{dp^W=0} \right\} \\ &= (-p_t + 1)X + D + tD' + (s - t) \frac{-p_t + 1}{p_Q} \\ &= (-p_t + 1)X + D + \frac{(-p_t + 1)s}{p_Q}, \end{aligned} \quad (24)$$

where the last line uses  $D' = (-p_t + 1)/p_Q$

Summing (22), (23) and (24) up and rearranging the terms, the welfare effect on Home becomes

$$\left. \frac{\partial W}{\partial t} \right|_{dp^W=0} = (p_t - 1)X + \frac{(-p_t + 1)s}{p_Q} = (-Xp_Q + s)D' = (p - c)D' < 0. \quad (25)$$

Eq. (25) implies that Home gains from the proposed tariff-tax reform.

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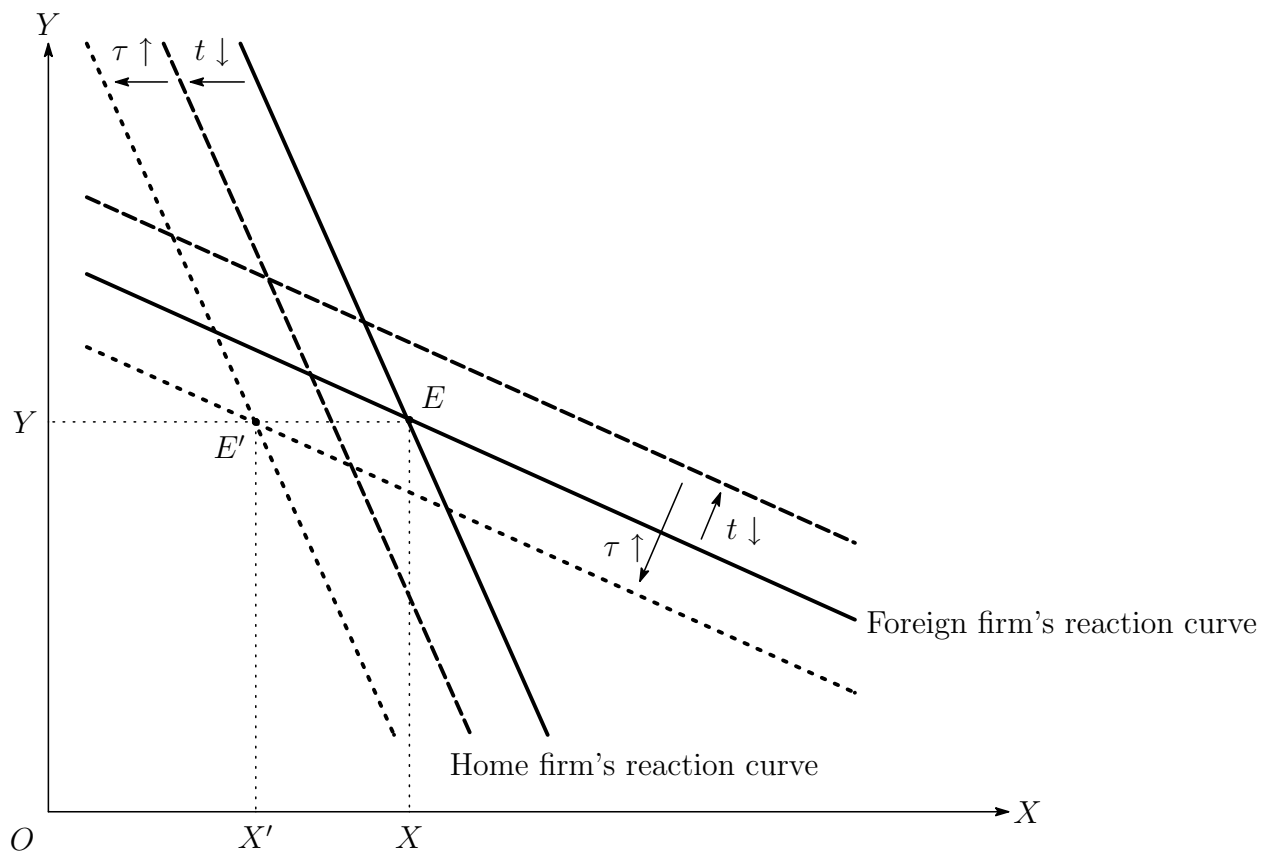


Figure 1: The Effect of the reform: destination principle



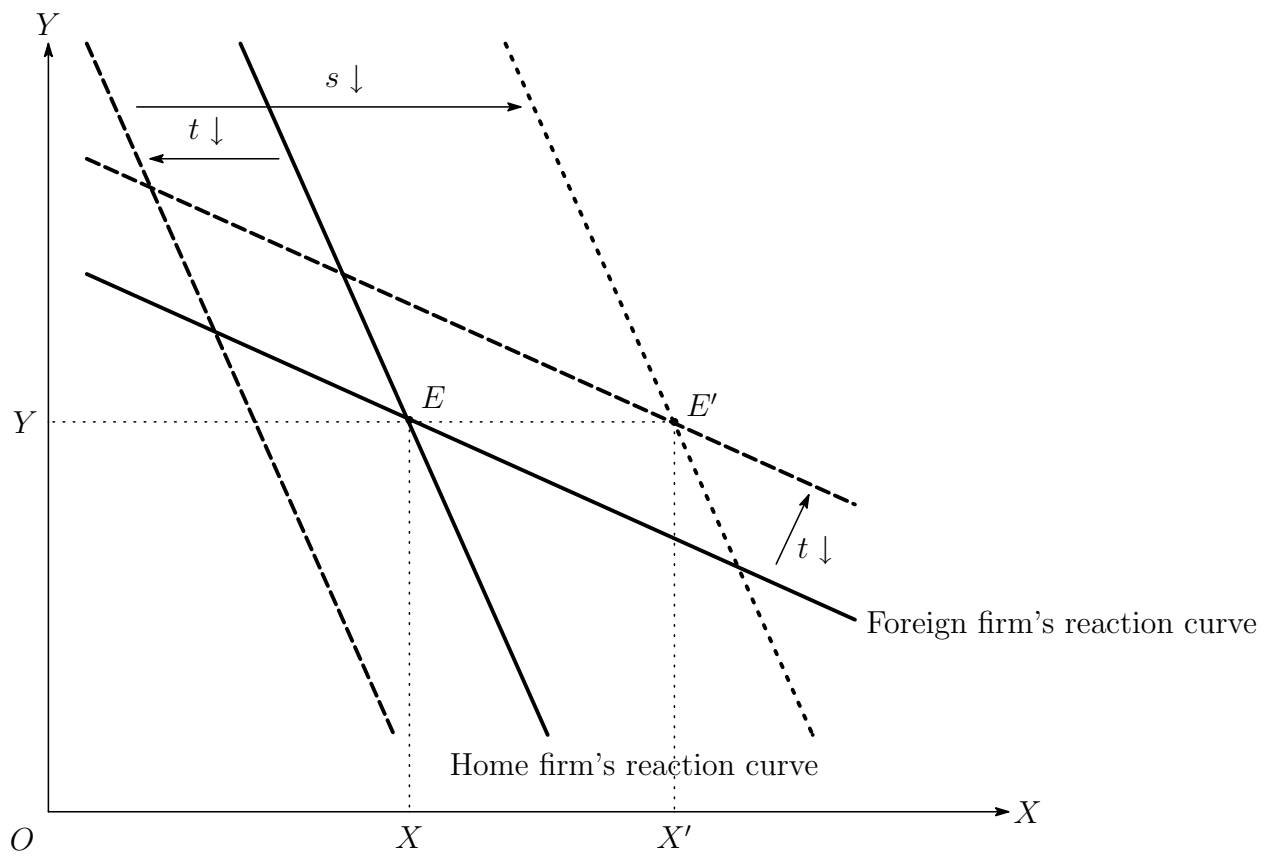


Figure 2: The Effect of the reform: origin principle

	$X$	$Y$	$p$	$CS$	$\pi$	$G$	$W$	$W^*$	$W + W^*$
consumption tax	−	0	+	−	−	?	−	0	−
production tax	+	0	−	+	+	?	+	0	+

Table 1: Effects of the reform